

**FISH AND WILDLIFE SERVICE
ENGINEERING AND CONSTRUCTION**

2.1 What is the purpose of this chapter? This chapter provides definitions for terms used in this Part and describes standards and requirements of the Dam Safety Program.

2.2 What are definitions for the terms used in this Part?

A. Dam. An artificial barrier, including appurtenant works, constructed for the purpose of storage, control, or diversion of water.

B. Dam Height. The vertical distance between the lowest point on the dam crest and the lowest point in the original streambed.

C. Hydraulic Height. The vertical distance between the maximum design water level and the lowest point in the original streambed.

D. Structural Height. The vertical distance between the maximum design water level and the lowest point of the excavated foundation.

E. Maximum Water Storage Elevation. The elevation commensurate with the maximum impounding capacity of the dam, including temporary storage of flood water.

F. Maximum Design Water Level. The elevation commensurate with the maximum water surface elevation as a result of safely passing the Inflow Design Flood (IDF).

G. Hazard Classification. Hazard Classification is a rating based on the potential loss of life or property damage downstream of a dam caused by failure or misoperation. Hazard Classification is not determined by the existing condition of a dam and its appurtenant structures or the anticipated performance or operation of a dam.

H. Inventory Dam. A dam is included in the Service Inventory of Dams and the National Inventory of Dams if it meets any of the following three criteria. (For example, if a dam is 6.5 feet high and impounds 51 acre-feet of water, it is considered to be an inventory dam.)

(1) It exceeds 25 feet in height from the natural bed of the stream (or a watercourse) measured at the downstream toe of the dam, or if it is not across a stream channel or watercourse, measured from the lowest elevation of the outside limit of the dam, to the maximum water storage elevation, **and** has a storage capacity at maximum water storage elevation in excess of 15 acre-feet.

(2) It exceeds an impounding capacity at maximum water storage elevation of 50 acre-feet **and** a height, measured

as in (1) above, of at least 6 feet.

(3) It has a high or significant hazard classification regardless of height or storage capacity.

I. Noninventory Dam. Noninventory dams are defined as follows:

(1) A low hazard dam that does not satisfy the criteria as set forth in the Inventory Dams (paragraph 2.2H).

(2) An interior dike or cross dike located within an impoundment or levee.

2.3 What are the standards and requirements of the Dam Safety Program?

A. Hazard Classification. The purpose of determining the hazard classification for a dam is to identify minimum requirements for security, investigation, design, and construction.

(1) A Regional Dam Safety Officer (RDSO) or a member of the Service's Dam Safety inspection team provides a preliminary hazard classification recommendation.

(2) The Division of Engineering (DEN) will perform a hazard classification analysis, when appropriate, in accordance with the latest version of Downstream Hazard Classification Guidelines, Department of the Interior, the Bureau of Reclamation (BOR), Assistant Commissioner Engineering and Research (ACER) Technical Memorandum (TM)#11.

(3) A hazard classification panel, as defined in this Part, assigns a formal hazard classification to all Service dams. The hazard classification panel will utilize the preliminary hazard classification recommendation, the hazard classification analysis, and other data to determine the hazard classification for a dam.

(a) The panel consists of a Service Dam Safety Officer (SDSO) designee(s), the appropriate RDSO and another RDSO mutually agreeable to the SDSO and the appropriate RDSO. The panel provides a written determination to the SDSO. A majority vote of the panel is required to classify new dams, and a unanimous vote of the panel is required to change the hazard classification of existing dams.

(b) The hazard classification panel determines the formal classification of a dam in accordance with the latest version of Downstream Hazard Classification Guidelines, Department of the Interior, the Bureau of Reclamation (BOR)..

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(4) The RDSO reviews the hazard classification of noninventory dams at least every 5 years.

(5) The RDSO and the SDSO have the authority to request the reclassification of a dam.

B. Size Classification. An RDSO or a member of the Service's Dam Safety inspection team determines the size classification of a dam. The structural height or the water storage capacity at maximum water storage elevation, whichever yields the larger size classification, is used to determine the size of a dam. For example, if a dam is 35 feet high (small size) and impounds 2,000 acre-feet of water (intermediate size), the dam would be classified as intermediate size. Size classification categories are as follows.

(1) Small dams are structures that are less than 40 feet high or that impound less than 1,000 acre-feet of water.

(2) Intermediate dams are structures that are 40 to 100 feet high or that impound 1,000 to 50,000 acre-feet of water.

(3) Large dams are structures that are more than 100 feet high or that impound more than 50,000 acre-feet of water.

C. New Dams.

(1) All plans, designs, drawings, and construction specifications for Service dams will be reviewed and approved as follows:

(a) The RDSO will perform the review and approval for noninventory dams.

(b) The RDSO and the SDSO will perform the review and approval for all low hazard, inventory dams.

(c) The SDSO will perform the review and approval for high and significant hazard dams. The SDSO will also attain an independent review by an outside organization such as the BOR, the Corps of Engineers or an independent consultant.

(2) Project Planning, Design, and Construction.

(a) The RDSO is responsible for the project planning, design, and construction of all low hazard, inventory, dams.

(b) The SDSO is responsible for the project planning, design, and construction of high and significant hazard dams.

(3) The RDSO classifies all new dams as either inventory or noninventory dams based on the vital statistics of the dam. The RDSO will forward this determination, along with the vital statistics of the dam, to the Chief, DEN.

D. Acquired Dams. A Formal Safety Evaluation of Existing Dams (SEED) inspection and report will be prepared for all dams acquired on "new" lands before the property where the dam is located is acquired.

(1) The SEED Inspection should be performed as a supplement to the Engineering Assessment (341 FW 2). The SEED Inspection should describe the condition of the dam and the cost of the work required to bring the dam up to Service safety standards.

(2) SEED II studies will be performed on all newly acquired dams. The SEED II study is a detailed assessment of the design and condition of the dam and will normally include hydrologic and hydraulic, structural, and geotechnical analyses (stability, seepage, liquefaction, etc).

(3) The acquisition contract or legally enforceable instrument should include the cost associated with work required to bring the dam up to Service safety standards. Land acquisition budget requests should include the costs for SEED Inspections and SEED II studies (341 FW 3).

E. Rehabilitation of Inventory Dams.

(1) Project planning, design and construction, review of project plans, engineering designs, and construction specifications for major rehabilitation, modification, or emergency repair of inventory dams will follow the procedures established for new dams (paragraph 2.3C). Major rehabilitation or modification may include such work items as raising a dam crest, enlarging or replacing spillways and outlets, constructing auxiliary or emergency spillways, and any alteration of the dam from its original design. Major rehabilitation, modification, or emergency repair does not include annual operation and maintenance work such as repairs to gates, repair of erosion on embankments, simple concrete repair, etc.

(2) Review of project plans, engineering designs, and construction specifications for a low hazard inventory dam will follow individual Regional policy.

F. The SEED Inspection Program. The purpose of the SEED Program is to ensure protection of life and property and to assure the integrity of Service inventory dams and appurtenant structures. These inspections are required by Federal Regulation. Periodic inspections disclose conditions that might disrupt operation or threaten dam safety. Deficiencies noted, as a result of inspections will be corrected. Priorities for correction will be assigned in accordance with the relative level of failure potential and

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downstream consequences. It may be necessary to determine the adequacy of structures and facilities to continue serving the purposes for which they were constructed, and to identify the extent of deterioration as a basis for planning maintenance, repair, rehabilitation, or intentional breaching.

(1) The SEED Inspector will immediately report all dangerous or unusual conditions to the Project Leader and the RDSO. The RDSO will immediately report them to the Regional Director or designee, in accordance with the Emergency Action Plan (EAPs), as appropriate. In addition, the RDSO must immediately contact the Regional Safety Manager if an inspection indicates imminent danger, or threat of serious injury or significant property damage.

(2) Periodic inspections for inventory dams include three types of inspections.

(a) Informal inspections consist of visual examinations carried out during day-to-day operations. They provide frequent surveillance of the general appearance and functioning of the dam and its appurtenances to identify, at the earliest possible time, any readily observable changes. These inspections are performed in accordance with the Standing Operating Procedures (SOPs) for high and significant hazard dams.

(b) Formal inspections are made for the purpose of providing an assessment of the safety and integrity of a dam in all aspects. Formal inspections are comprehensive searches for evidence of deterioration of materials, developing weaknesses, and unsafe hydraulic or structural conditions. These inspections consist of field examinations, video recording of all physical features, examination of any adjacent endangering conditions, and review and evaluation of all performance data recorded, including instrumentation and spillway discharge measurements. Formal inspections also include the use of advanced methods and current design criteria and practices where appropriate to evaluate the performance of the dam and a comparison of the long-term examination record with current conditions. Formal inspections also include an overall condition rating and recommendations to maintain or improve the integrity of the dam.

(c) Special inspections are made following (or during, if possible) unusual floods, significant earthquakes, mishaps, or the appearance of unexpected dam performance. These inspections are made to determine the extent of any damage and the need for emergency repair or other action.

(3) Frequency of inspections for Service inventory dams.

(a) Informal inspections are performed routinely during day-to-day operations. These inspections are ongoing and need not be scheduled or as documented in the SOPs.

(b) Frequency for formal inspections is determined by the hazard classification of the dam.

(i) High and significant hazard dams have a formal inspection every 2.5 years.

(ii) Low hazard dams have a formal inspection every 5 years.

(c) Frequency of special inspections depends upon the occurrence of an unusual event (e.g., seepage through the dam has become turbid). Consequently, it is not possible or necessary to establish cyclical evaluation frequencies for special inspections. However, those responsible for the dam must be alert to identify situations or occurrences that may require reevaluation.

(4) Inspector qualifications.

(a) Inspectors for informal inspections are project leaders, dam operators, and other individuals who are in the vicinity of the dam in the course of their regular activities, or as prescribed by the RDSO. These individuals should have a basic knowledge of dams so they may recognize unusual conditions, abrupt changes from previous conditions, and obvious new defects such as seepage, cracks, and displacements.

(b) The DEN, or DEN consultants, performs formal inspections of high and significant hazard dams. Registered Professional Engineers or Registered Geologists trained in the safety inspection of dams will compose the inspection team.

(c) The DEN, or DEN consultants, perform formal inspections of low hazard dams. Dam safety professionals will perform the inspections under the direct supervision of a Registered Professional Engineer trained in the safety inspection of dams.

(5) Inspection reports.

(a) Informal inspection reports may be written or oral. They follow a checklist format and contain enough information to allow a determination to be made regarding whether or not further action is necessary.

(b) Formal inspection reports are written reports prepared in a format consistent with established Service guidelines.

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G. Standing Operating Procedures. The SDSO will prepare SOPs for all high and significant hazard dams. The SOPs are prepared in accordance with Service guidelines.

(1) The RDSO will annually review and update, as appropriate, the SOPs for each high hazard and significant hazard dam within the Region in accordance with procedures outlined in the SOPs.

(2) The SDSO is responsible for updating SOPs associated with major repair or rehabilitation to high and significant hazard dams.

H. Emergency Action Plans (EAPs). The SDSO will prepare EAPs for all high and significant hazard dams. The EAPs are prepared in accordance with Service guidelines (095 FW 9).

(1) The RDSO will perform an EAP annual review for each high and significant hazard dam within the Region in accordance with procedures outlined in the EAPs. The RDSO is responsible for annual testing, verification and certification of EAPs by November 1st of each year. The RDSO is responsible for submitting a verification statement, in accordance with the SOPs, along with any revisions to the EAPs, to the SDSO, annually, on or before November 30th.

(2) The SDSO is responsible for performing EAP periodic tests every 5 years in accordance with procedures in the EAPs.

(3) The SDSO is responsible for updating EAPs associated with major repair or rehabilitation to high and significant hazard dams.

I. Coordination with State Dam Safety Programs. The Service consults fully with any State, in which it owns, operates, or proposes to construct a dam on the design and safety of that dam. State officials are invited to participate in all safety inspections of Service dams.

J. Inspection of Private Dams. Non Federal dams located on Service property are inspected in accordance with State regulations. Service inspection teams do not inspect private dams, but a listing of those dams is maintained by the Chief, DEN. If difficulties or unusual circumstances are encountered, the SDSO should be contacted for advice and guidance.

K. Requirements for Federal Aid Dams. Federal funds are used to supplement approved State dam safety projects on a cost-sharing basis through the Federal Aid Program. The Service will review and approve Federal Aid Dams in accordance with procedures established for new dams (361 FW 2.3C). States are to provide a written certification, signed by a Registered Professional

Engineer, certifying that proposed projects involving the construction, enlargement, or rehabilitation of any dam (including appurtenant works) that satisfies the criteria for the Service's inventory as defined in (361 FW 2.1) meet Federal requirements. These requirements do not apply to any dam that does not satisfy the criteria for the Service's inventory. A Registered Professional Engineer must certify each of the following:

(1) That the hazard and size classification of the dam are correct and that its present condition and deficiencies have been accurately identified;

(2) That the proposed project has been designed to meet Federal standards for dam design, construction, and rehabilitation including, but not limited to, the Federal Guidelines for Dam Safety (June 25, 1979), Recommended Guidelines for Dam Safety--Inspection of Dams (Corps of Engineers, 1974), and any other technical requirements identified in the Federal Aid project agreement documents; and

(3) That the technical review of the project design and specifications by the State has been completed by a Registered Professional Engineer qualified in the design and construction of dams.

L. Privately Funded Dams. The review and approval of privately-funded dams on Service property will be in accordance with the procedures established for new dams (paragraph 2.3C).

2.4 What are the technical standards for the Dam Safety Program? The planning, design, construction, and rehabilitation of all inventory dams will follow the technical standards documented in this Part. All other technical standards not specifically included in this section are in accordance with standards set forth in (361 FW 1).

A. Inflow Design Flood. The Inflow Design Flood represents the largest flood hydrograph a dam is capable of safely passing through a combination of spillway and outlet works capacity and attendant surcharge storage.

(1) Existing inventory dams constructed prior to January 1, 2002, should be evaluated according to information found in Exhibit 1 for determining the Inflow Design Flood.

(2) New inventory dams constructed, or which have had major reconstruction on or after January 1, 2002, should be evaluated according to information found in Exhibit 2 for determining the Inflow Design Flood.

(3) The Chief, DEN and the SDSO must approve a waiver from the Inflow Design Flood requirements shown in Exhibits 1 and 2 for high and significant hazard dams. The SDSO and the RDSO must approve a waiver from the Inflow Design Flood requirements shown in Exhibits 1 and

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2 for a low hazard, inventory dams. Inflow Design Floods other than those in Exhibits 1 and 2 will be approved only after performing an incremental damage assessment or risk-based analysis to determine if tradeoffs and other factors are relevant.

(a) Detailed studies and mapping must clearly demonstrate that consequences of dam failure at flood flows larger than the selected Inflow Design Flood causes no incremental increase in projected loss of life and no significant incremental increase in property damage. Federal Emergency Management Agency 97, Federal Guidelines for Selecting and Accommodating Inflow Design Floods for Dams, or a more conservative approach, will be followed. Analysis will include existing structures and inhabitants and projected inhabitants and structures in the next 50 (minimum) years. The incremental increase in property damage versus a flood frequency event will be clearly identified in a management decision chart and understood by decision making officials.

(b) The annual probability of loss of life and failure of the structure and corresponding probabilities over a projected 50-year period should be clearly demonstrated. The average annual loss of life probability will be less than 1 in 1000. The annual failure probability of the structure will be less than 1 in 10,000.

(c) The RDSO or the SDSO will provide the proposed Inflow Design Flood using an Incremental Damage Assessment or Risk-based Analysis to the respective state dam safety office for review and discussion.

(d) Under no circumstance will an Inflow Design Flood less than the 100-year flood frequency event be approved for high or significant hazard dams.

B. Freeboard Requirements. Freeboard requirements are as set forth in ACER TM No. 2, "Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams."

C. Low-Level Outlets. All inventory dams must have a low-level outlet. The low-level outlet must be able to evacuate the major portion of the reservoir storage volume by gravity flow. The RDSO and the SDSO must justify and approve a waiver to this requirement. However, criteria for reservoir draining should recognize site-specific conditions, economic aspects, and project needs to provide an acceptable balance between costs and rates of draining and filling. Draining times established for a dam reflect downstream channel capacity, level of risk to the dam, and hazard potential to the downstream areas. A low-level outlet works, in conjunction with other release facilities, should be located and sized to draw down the reservoir in accordance with Criteria and Guidelines for

Evacuating Storage Reservoirs and Sizing Low-level Outlet Works, ACER TM No. 3, the Department of the Interior, BOR 1990 or the latest revision. As a minimum for small low-hazard inventory dams, the low-level outlet works, in conjunction with other release facilities, should be located and sized to draw down the reservoir within 1 to 4 months to the lower of the following levels:

- (1) The reservoir level commensurate with a storage capacity that is 10 percent of that at the normal reservoir level, or;
- (2) The reservoir level with less than 50 percent of the hydraulic height.

2.5 How is funding for safety of dam modifications requested? Funds for maintenance, repair and rehabilitations to existing dams to correct identified deficiencies are requested as follows:

A. The Project Leaders and Regional Maintenance Management System (MMS) Coordinators should request Resource Management funds for routine maintenance, operations and monitoring, minor repairs of all high, significant and low hazard dams through the MMS.

B. The Project Leaders and Regional MMS Coordinators should request Resource Management funding for Priority 1 and Priority 2 recommendations identified during SEED inspections, with the exception of major repair or rehabilitation recommendations, the year they are identified, through the MMS.

C. The Project Leader, in consultation with the RDSO and the Regional Engineer, should request Resource Management or Construction funding for planning, design, and construction of major rehabilitation or modification to a low hazard dam and/or appurtenances. Funding should be requested through the MMS or the Construction Five-Year Plan.

D. The SDSO, through the Chief, DEN, should request funding for major repair or rehabilitation to high and a significant hazard dams and/or appurtenances through the Construction Five-Year Plan.